Greater Experimental Capabilities to Come

The greatest challenges in stockpile stewardship lie ahead as weapons continue to age. Success depends on bringing into operation vastly improved scientific capabilities, including the National Ignition Facility (NIF). With NIF, scientists will perform vitally needed thermonuclear weapons physics experiments. Offering the promise of reaching the long-sought goal of thermonuclear ignition and energy gain, NIF is the latest in a 30-year history of laser design, construction, and operation at Livermore to achieve inertial confinement fusion.

NIF Progress and Completion of Conventional Construction

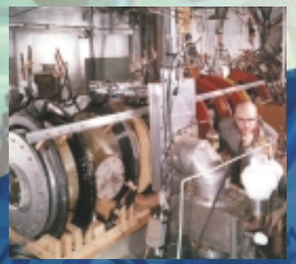
Significant progress was made in 2001 on construction of the National Ignition Facility (NIF). A major milestone was reached in September with completion of NIF's conventional facilities—the stadium-size laser and target building and the optics assembly building. In October, the project completed installation of one-quarter of NIF's beampath infrastructure. Now in place are the precision-cleaned enclosures for the components of 48 laser beams. A strong partnership between the Laboratory, Jacobs Facilities Inc. (the contractor for installation, management, and integration), and the local building and crafts trade unions has enabled the project to achieve these key milestones.

The NIF team continues to make outstanding technical progress. Nearly 80 percent of the required 3,072 high-quality laser glass slabs are ready, and over half of the large crystals used for optical switches and frequency conversion have been grown. New Livermore-developed optical finishing techniques show promise for increasing the durability of NIF's final optics. The clean-room facilities are being commissioned, and production has begun on some components. NIF's clean assembly, transport, and installation requirements were validated with the installation of a laser-glass slab assembly into the main amplifier.

The NIF team's goal is to achieve "first light" in 2003 by delivering 10 kilojoules in four infrared laser beams through the entire laser chain into a diagnostics station. Soon thereafter, these four laser beams will be transported to the final optics assembly, where they will be converted to ultraviolet light and focused to the center of the target chamber. This achievement will provide validation and confidence in all of NIF's systems and will allow commissioning activities to begin.

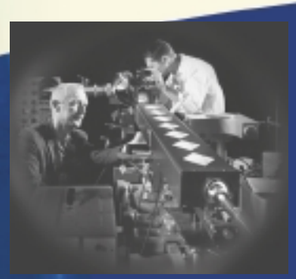
As more of NIF comes on line, fundamental physics regimes for materials science, high-energy-density science, and thermonuclear ignition and burn will become accessible for study. NIF will provide temperatures and pressures needed to validate computer codes and address important issues of national security and basic science.

1950s



To accelerate improvements to the U.S. strategic arsenal, Laboratory scientists worked to develop a better theoretical understanding of thermonuclear weapon design. At the same time, Project Sherwood was exploring the possibility of controlled fusion. An interest common to both was fielding the smallest thermonuclear event feasible.

1960s



Shortly after the laser was invented in 1960, Livermore scientists performed computer calculations to study the possibility of using powerful lasers to compress and ignite a small quantity of deuterium–tritium fuel. In 1962, the Laboratory began a small project to explore the possibility of laser fusion and other laser applications.

1970s

Improved computer calculations showed that important laser fusion experiments could be performed with a 10-kilojoule laser and that ignition and significant gain could be achieved with a megajoule-size laser. Livermore's Inertial Confinement Fusion (ICF) program was born in 1972, and by 1974, the first ICF laser, Janus, was built.

1980s

Experiments on Shiva and Novette paved the way for Nova, a 10-beam laser that became operational in 1985. Using Nova and other lasers, as well as underground nuclear experiments, scientists made important progress in understanding ICF. A powerful x-ray laser was produced using a special two-beam configuration of Nova.

1990s

Nova experiments contributed to stockpile stewardship science and engineering issues, and petawatt power levels were demonstrated on Nova. Using the Beamlet laser, Laboratory researchers achieved breakthroughs needed for the National Ignition Facility (NIF). Construction of NIF, a cornerstone of the Stockpile Stewardship Program, began in 1997.